

WHAT IS CLAIMED IS:

1. An electromagnetic drive type actuator comprising:

a movable plate having a flat surface;

5 a support positioned around the movable plate;

an elastic member, which is elastically deformable, connecting the movable plate with the support, the elastic member supporting the movable plate so as to allow the movable plate to move in 10 directions orthogonal to the flat surface of the movable plate;

wirings, which carry currents, extending through the support, the movable plate, and the elastic member; and

15 magnetic field generating means for generating a magnetic field in a space around the movable plate, the magnetic field having a direction parallel to the flat surface of the movable plate, so that the movable plate is moved in the directions orthogonal to the flat 20 surface of the movable plate by a mutual effect between the currents flowing through the wirings and the magnetic field generated by the magnetic field generating means.

25 2. The electromagnetic drive type actuator according to claim 1, wherein the elastic member has a mesh structure.

3. The electromagnetic drive type actuator

according to claim 1, wherein the elastic member comprises parts extending in two directions, which are not parallel to each other.

4. The electromagnetic drive type actuator  
5 according to claim 3, wherein the two non-parallel directions, along which the parts constituting the elastic member extend, are orthogonal to each other.

5. The electromagnetic drive type actuator  
according to claim 4, wherein the magnetic field has a  
10 direction of 45° with respect to the two directions,  
along which the parts constituting the elastic member  
extend and which are orthogonal to each other.

6. The electromagnetic drive type actuator  
according to claim 5, wherein the magnetic field  
15 generating means comprise two permanent magnets  
arranged on both sides of the movable plate.

7. The electromagnetic drive type actuator  
according to claim 5, wherein the magnetic field  
generating means comprise electromagnets.

20 8. The electromagnet drive type actuator  
according to claim 1, wherein the elastic member  
comprises parts extending in a direction.

9. The electromagnetic drive type actuator  
according to claim 8, wherein the magnetic field has a  
25 direction orthogonal to the direction, along which the  
parts constituting the elastic member extend.

10. The electromagnetic drive type actuator

according to claim 9, wherein the magnetic field generating means comprises two permanent magnets arranged on both sides of the movable plate.

11. The electromagnetic drive type actuator  
5 according to claim 9, wherein the magnetic field generating means comprises electromagnets.

12. An electromagnetic drive type actuator comprising:

a movable plate having a flat surface;  
10 a support positioned around the movable plate;  
an elastic member, which is elastically deformable, connecting the movable plate with the support, the elastic member supporting the movable plate so as to allow the movable plate to move in  
15 directions orthogonal to the flat surface of the movable plate and directions parallel to the same;  
wirings, which carry currents, extending through the support, the movable plate, and the elastic member;  
and  
20 magnetic field generating means for generating a magnetic field in a space around the movable plate, the magnetic field being one of a first magnetic field having a direction parallel to the flat surface of the movable plate and a second magnetic field having a  
5 direction orthogonal to the same, the magnetic field generating means selectively generating one of the first magnetic field and second magnetic field, so that  
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the movable plate is moved in the directions orthogonal to the flat surface of the movable plate or the directions parallel to the same by a mutual effect between the currents flowing through the wirings and the magnetic field generated by the magnetic field generating means.

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13. The electromagnetic drive type actuator according to claim 12, wherein the elastic member has a mesh structure.

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14. The electromagnetic drive type actuator according to claim 12, wherein the elastic member comprises parts extending in two directions which are not parallel to each other.

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15. The electromagnetic drive type actuator according to claim 14, wherein the two non-parallel directions, along which the parts constituting the elastic member extend, are orthogonal to each other.

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16. The electromagnetic drive type actuator according to claim 12, wherein the elastic member comprises parts extending in a direction.

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17. The electromagnetic drive type actuator according to claim 12, wherein the magnetic field generating means comprises a first electromagnet that generates a first magnetic field, as necessary, and a second electromagnet that generates a second magnetic field, as necessary.

18. An electromagnetic drive type actuator

comprising:

a movable plate having a flat surface;  
a support positioned around the movable plate;  
an elastic member, which is elastically  
5 deformable, connecting the movable plate with the  
support, the elastic member supporting the movable  
plate so as to allow the movable plate to move in  
directions orthogonal to the flat surface of the  
movable plate;  
10 wirings, which carry currents, extending through  
the support, the movable plate, and the elastic member;  
and  
15 a magnetic field generator, which generates a  
magnetic field in a space around the movable plate, the  
magnetic field having a direction parallel to the flat  
surface of the movable plate, so that the movable plate  
is moved in the directions orthogonal to the flat  
surface of the movable plate by a mutual effect between  
the currents flowing through the wirings and the  
magnetic field generated by the magnetic field  
generator.

19. The electromagnetic drive type actuator  
according to claim 18, wherein the elastic member has a  
mesh structure.

20. The electromagnetic drive type actuator  
according to claim 18, wherein the elastic member  
comprises parts extending in two directions, which are

not parallel to each other.

21. The electromagnetic drive type actuator according to claim 20, wherein the two non-parallel directions, along which the parts constituting the 5 elastic member extend, are orthogonal to each other.

22. The electromagnetic drive type actuator according to claim 21, wherein the magnetic field has a direction of 45° with respect to the two directions, along which the parts constituting the elastic member 10 extend and which are orthogonal to each other.

23. The electromagnetic drive type actuator according to claim 18, wherein the elastic member comprises parts extending in a direction.

24. The electromagnetic drive type actuator 15 according to claim 23, wherein the magnetic field has a direction orthogonal to the direction along, which the parts constituting the elastic member extend.

25. An electromagnetic drive type actuator comprising:

20 a movable plate having a flat surface;  
a support positioned around the movable plate;  
an elastic member, which is elastically deformable, connecting the movable plate with the support, the elastic member supporting the movable 25 plate so as to allow the movable plate to move in directions orthogonal to the flat surface of the movable plate and directions parallel to the same;

wirings, which carry currents, extending through the support, the movable plate, and the elastic member; and

5 a magnetic field generator, which generates a magnetic field in a space around the movable plate, the magnetic field being one of a first magnetic field having a direction parallel to the flat surface of the movable plate and a second magnetic field having a direction orthogonal to the same, the magnetic field generator selectively generating one of the first 10 magnetic field and second magnetic field, so that the movable plate is moved in the directions orthogonal to the flat surface of the movable plate or the directions parallel to the same by a mutual effect between the 15 currents flowing through the wirings and the magnetic field generated by the magnetic field generator.

26. The electromagnetic drive type actuator according to claim 25, wherein the elastic member has a mesh structure.

20 27. The electromagnetic drive type actuator according to claim 25, wherein the elastic member comprises parts extending in two directions, which are not parallel to each other.

25 28. The electromagnetic drive type actuator according to claim 27, wherein the two non-parallel directions along which the parts constituting the elastic member extend, are orthogonal to each other.

29. The electromagnetic drive type actuator according to claim 25, wherein the elastic member comprises parts extending in a direction.